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COST STATISTICS OF PUBLIC ELECTRIC LIGHTING.

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Among the various papers published upon the subject of municipal control of public electric lighting the showing made by the statistics of cost is always an important factor. Whatever be the point of view of the writers, they seem to present their own figures and yet to arrive at essentially inconsistent results. What I propose to do here, then, is simply to touch upon a few of the limitations which must be borne in mind by anyone who wishes to give these statistics their due scientific weight.

I. Contract Prices.

What is the cost of an electric street-lamp to a city? The answer naturally suggesting itself would be that it is the contract price paid to the lighting corporation. If we have this sum, then we can compare the prices paid in different cities and judge whether the one is being more imposed upon by a so-called relentless monopoly than the other. This is evidently the idea that controlled the officials of the Eleventh Census when they compiled the materials for Census Bulletin No. 100. In that document they present the number of electric street-lamps employed in fifty different cities, the annual cost of each lamp, and the ratio of cost to each head of population. No extended consideration is needed to learn that these figures are absolutely without significance. The fatal defect lies in the fact that they do not show the amount of lighting service. In one place the lamps may burn but five hours nightly for only twenty nights in the month; in another they may be operated all of every night. Even overlooking minor omissions, which will be pointed out in a moment, any comparison of absolute contract prices is fallacious at the outset. In this respect the Census Bulletin is not the only transgressor; of the many tables illustrating this point, which are found in popular discussions, those that have escaped this initial stumbling-block may be counted without great difficulty.

Leaving aside the Census Bulletin, we may, nevertheless, still find an authoritative presentation of contract prices of public electric lighting that does not have its chief merit in giving too little information. I refer to a report of the Engineer Commissioner of the District of Columbia,[1] from which Table I has been extracted.

Here, notwithstanding the fact that only those cities have been selected in which the lamps burn a period popularly known as "all of every night," the actual period of illumination is given in each instance. We also have data upon several collateral points. Important among these are the terms of the contracts in force. In these cities they vary from monthly renewals to a duration of ten years. The bearing of this point upon the question of price is this: If a city advertises at the same time for bids for lighting under contracts for one, three, five, or ten years, respectively, it will be found that the proposals for different terms will vary materially. The difference between a certainty of work and an uncertainty of work will be calculated on a money basis by the contractor, and will find assertion in the prices offered. To compare the cost of an electric lamp supplied under a ten-year contract with that of one supplied under monthly agreements cannot be strictly accurate.

Again, the location of the wires may be a factor influencing the cost of street illumination to a city, in which the municipal authorities compel the franchised corporations to place their wires under ground. What they in fact do is to compel an increased capitalization of the private company in order to meet the extraordinary expenditure. The larger

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[1] 51st Cong., 2nd Sess., Senate Misc. Doc. No. 56.

TABLE I. ARC LAMPS OF 2000 NOMINAL CANDLE-POWER. DECEMBER, 1890.

Cities.	Number of Arc Lamps.	Contract Price per Lamp per Year.	Nightly Period of Illumination.	Term of Contract.	Location of Wires.
New York	883	$123.73*	Sunset to sunrise	Annual	A few under ground.
Chicago	112	175.00	Dusk to daylight		Overhead.
Philadelphia	1,293	174.29*	Sunset to sunrise	Annual	“ and under ground.
Brooklyn	1,528	182.50	30 minutes after sundown to 30 minutes before sunrise.	“	“
St. Louis	1,822	74.95	30 minutes after sundown to 45 minutes before sunrise.	Ten years	“
Boston	1,125	146.00	Sunset to sunrise		“
Baltimore	655	127.75	Sunset to break of day	Five years	“
Cincinnati	27	144.00	All of every night	Monthly	“
Cleveland	105	139.12	“ “ “ “	Annual	“
Buffalo	1,455	146.00	“ “ “ “	“	“ and under ground.
New Orleans	1,013	134.76*	Sunset to sunrise	Five years	“
Pittsburgh	920	100.00	Dusk to daylight	Three years	“
Detroit	827	140.05	30 minutes after sunset to 30 minutes before sunrise.	“ “	One half mile under ground.
Milwaukee	417	112.50	Sunset to sunrise	One year	Over head and under ground.
Newark	420	146.00	All of every night	Five years	“
Jersey City	87	85.82	Sunset to sunrise	Annual	“
Louisville	6	127.75	All of every night	“	“
Omaha	117	175.00	“ “ “ “	Five years	“
Rochester	1,142	102.20	Sunset to sunrise	Two to five years	“
Kansas City	125	200.75	All of every night		“
Providence	650	160.60	30 minutes after sundown to 30 minutes before sunrise.	Five years	“
Indianapolis	112	62.25*	All of every night	Annual	“
Denver	221	198.90*	“ “ “ “	Five years	“
Allegheny	16	180.00	Dusk to daylight	Annual	“
Average of 24 cities	628.3	140.00			
Washington	206	219.00	Sunset to sunrise	Annual	All under ground.

* Average.

capitalization — in this instance actual and legitimate — can scarcely fail to register an influence upon the price of the product. Those cities in which the wires are in part under ground are undoubtedly expending more for their street illumination than they would otherwise be paying. An illustration may be drawn from the condition of affairs in New York City. The lighting is here distributed without competition among the six companies, which have divided the field with one another. Those located in the business districts secure a slight differential on account of the under ground wiring. In any precise comparison of cost statistics, differences in the location of wires ought to be given a qualified consideration.

Analogous to the distinction just noted are the differences founded in the location of the lamps. These differences take on three distinct forms with reference to the system of hanging, with reference to the number of lamps, and with reference to the relative profitableness of the district.

First, the lamps may be erected upon towers, upon poles, or at street intersections. These different systems necessitate a different expenditure for the particular lighting apparatus. The towers are often quite expensively built. Unlike poles, they are with difficulty removed from one place, where they are no longer wanted, to a place where they are demanded. The poles and gearing for intersection lamps, on the other hand, are comparatively inexpensive.

Second, the lamps may be supplied in clusters or distributed singly. When placed upon towers the usual custom is to bunch a considerable number of lights. The new lamps on Fifth Avenue in New York are erected two on each pole. Most commonly, however, the lamps, when placed upon poles or hung at street intersections, are supplied singly only. Differences in this particular result in differences in the labor service needed. To renew the carbons in two lamps upon one pole requires less than twice the labor of renewing them in two lamps on different poles. The frequency of the lights has a bearing of a similar character. It is less laborious to attend to many lamps in a small area than to fewer lamps scattered over a wide area.

Third, a private company will be influenced in making bids for public street lighting by the profitableness of the district to be lighted. The business of supplying electric lighting is acknowledged to be one which follows the economic law of increasing returns. Sir John Pender, in his report as president to the directors of the Metropolitan Electrical Supply Company, Limited, of London, said, about a year and a half ago: "Our working expenses in the past, and even at present, are, with few exceptions, the same to all intents and purposes as they will be when we are giving our present maximum supply of 114,000 lights. When I state to you that we have made a small profit on the out-turn of 30,000 lights, it does not require a great amount of imagination to see that it must be a very good business if we can conduct 114,000 lights with a comparatively small increase of expenses." An equally apt illustration of this point appeared recently in New York City in connection with the annual reletting of lighting contracts. The bid of the United States Electric Light Company was for 50 cents a night per light for 17 lamps, and 40 cents a night for 351 lamps. The increase of ten cents a night was demanded in those streets only where no other business outside of the public lighting could be secured. In this case the difference in conditions was reduced to a money measurement,—$36.50 per lamp per year. A factor of such dimensions ought not to be lost sight of in making systematic comparisons.

II. COST UNDER MUNICIPAL OWNERSHIP.

If we turn now to the cost statistics of electric lighting under municipal ownership of the plant, we strike a set of complications no less serious. At the very beginning of every such investigation we find ourselves in the chaos of American municipal book-keeping. When no two cities employ the same system of accounts, when in the same city the reports of different departments furnish irreconcilable data, the statistician must seek to extricate himself as best he can. It would scarcely be stating the case too strongly if we should say that out of the probable 150 municipalities owning their own electric lighting plants not five could present an intelligible showing of their operations for the period of one year. The blame for this does not attach entirely to the city officials, for conditions exist in many localities which render a clear financial account a thing next to impossibility. As an example of a concise and commendable statement of the workings of a municipal plant, I cite that relating to Topeka, lately communicated by Mr. Lewis Kingman to the American Society of Civil Engineers, and given as Table No. II.

The special difficulties arising in this connection are of a two-fold character,— those relating to the cost of the installation, and those relating to the annual operating expenses. In most instances the bonded indebtedness incurred for the particular purpose does not cover the entire capital outlay. To add in the proper amount of interest charges requires, then, an assumed capitalization. Where the plant is conducted in conjunction with other monopolies of service, with the water-works, for example, we have a system of joint production, which defies a statistical separation of expenditures. The same obstacle presents itself in relation to the operating expenses. The superintendent may devote only a portion of his time to electric lighting; the line men may attend to the fire-alarm telegraph; the engineers and firemen may be employed at the same time in more than one department. Again, the geographical situation has much to do with determining the cost of the motive power, whether or not water power may be used, or, if steam, the quantity and quality of the fuel. Still another bone of contention lies in the percentage of depreciation to be added to the expense account. This must at all events be an assumed calculation. In Table No. III, prepared by the Electrical Commission of

TABLE 15. COST OF OPERATING THE TOPEKA ELECTRIC LIGHT PLANT, OWNED AND RUN BY THE

Year and Month.		Nights Run During Month.	Hours Run During Month.	Average Number of Hours Run.	Coal.		Cost of Coal per Horse Power.		Cost of Carbons.	Cost of Globes.	Cost of Oil and Waste.	Cost of Repairs.
					Tons.	Cost	Per Night	Per Hour.				
1889.	Nov.	28	346.16	12.34	206.10	$560.41	5.00	0.71	$112.00	$15.50	$22.[illegible]	$12.1[illegible]
	Dec.	30	375.17	12.58	201.56	528.42	5.30	0.71	137.40	4.25	27.27	133.71
1890.	Jan.	29	361.40	12.82	227.10	577.07	7.82	0.68	146.40	16.70	24.18	107.07
	Feb.	28	328.70	11.69	216.50	520.42	8.12	0.64	133.00	9.00	21.77	154.94
	March.	27	271.58	10.05	194.55	450.43	7.86	0.71	122.00	12.50	22.12	150.16
	April.	30	263.42	8.84	190.50	480.02	6.17	0.78	104.07	13.38	22.50	54.25
	May.	28	171.28	6.21	164.80	372.41	8.18	0.80	79.37	4.17	21.50	57.47
	June.	21	182.21	4.32	75.30	182.50	8.57	0.58	58.50	6.50	22.25	95.01
	July.	28	142.64	5.08	110.16	280.52	4.81	1.82	57.00	4.50	14.00	101.74
	August.	25	122.50	4.11	144.80	316.75	5.85	0.80	71.97	2.50	21.90	16.76
	Sept.	27	211.80	7.57	161.76	408.22	6.80	0.61	47.96	3.00	25.22	40.85
	Oct.	23	274.00	8.16	160.10	300.17	8.13	1.75	75.16	5.00	22.50	62.78
	Nov.	24	208.60	6.56	196.75	380.12	7.50	0.80	74.08	4.00	22.50	70.75
	Dec.	25	188.55	7.70	132.16	300.72	6.91	0.80	25.66	3.50	16.71	86.17
1891.	Jan.	21	160.57	7.56	122.86	276.74	6.21	0.64	57.10	2.00	15.29	100.23
	Feb.	27	132.50	7.50	80.76	260.14	6.06	0.65	65.72	8.50	17.50	156.84
	March.	29	135.50	0.50	102.40	207.77	5.91	0.61	75.10	9.50	12.38	102.11
	April.	31	130.68	6.05	108.70	217.13	6.63	0.76	51.80	5.00	11.46	41.72
	May.	26	132.16	5.78	101.00	224.51	5.96	0.80	60.00	3.00	11.70	56.79
	June.	28	115.08	4.38	84.40	192.74	4.80	5.86	55.50	1.00	9.33	100.21
	July.	25	177.35	5.14	55.16	201.72	5.36	0.71	55.80	4.00	10.28	21.40
	August.	26	170.06	6.11	93.20	272.42	4.17	0.82	72.00	3.00	14.78	67.57
	Sept.	30	246.06	8.17	106.85	331.57	4.50	0.56	75.00	8.00	20.[illegible]0	171.45
	Oct.	16	147.35	9.25	100.22	380.21	5.10	0.56	60.00	2.00	17.85	70.77
	Nov.	26	211.41	8.[illegible]	126.45	316.72	1.01	7.09	97.00	4.50	17.50	110.37
	Dec.	21	227.80	9.6[illegible]	116.29	410.29	6.06	0.77	98.00	4.00	15.40	74.22
Totals		642	5,420.72	Av., 8.04	3,257.03	$9,210.14	Av., 6.11	Av., 0.70	$2,160.21	$170.16	$548.8[illegible]	$2,160.7[illegible]
Per cent of total expenses						36.06	...	...	8.70	0.48	2.08	8.[illegible]8

Cost of lots and buildings, $9,110.28; cost of plant, poles and wire, $46,[illegible]8.10; total co

This plant consists of a building and a [illegible] with a [illegible] switch [illegible] the rear; there are three boilers and three engines, worked up to 250 horse-pow
There are six circuits, with 29.75 miles of [illegible] and 30.5 miles of wire. The line poles are 40 feet long, of which there are [illegible]. The lamps are [illegible]
every other intersection, making them 1100 feet apart one way and 600 feet the other. Together there are 166 arc lamps rated at 2000 candle power,
10.0 amperes, 450.85 watts, or 1958 nominal candle power.

N THE CITY OF TOPEKA, KANSAS.

st of pairs.	Renewals, [illegible] Telephones.	Pay Roll of Superintendent and [illegible]	Interest on Cost of Plant, at 6 Per Cent.	Total Cost Entire Expense per Month.	Cost per Lamp per Month.	Cost per Lamp per 100 Hours.
[illegible]	$32.88	$460.[illegible]	$277.24	$1,[illegible]	$8.20	$2.43
[illegible]	30.69	501.50	277.24	1,728.68	8.05	3.60
[illegible]	30.66	497.50	277.24	1,601.27	9.21	3.16
[illegible]	36.64	496.25	277.24	1,592.63	8.88	[illegible]
150.16	20.62	492.50	277.24	1,710.84	5.71	3.37
[illegible]	32.91	500.[illegible]	277.24	1,[illegible]	[illegible]	3.11
97.27	30.32	504.35	277.24	1,319.[illegible]	7.17	4.17
[illegible]	31.81	510.[illegible]	277.24	1,255.62	6.[illegible]	1.80
101.74	37.81	521.[illegible]	277.24	1,[illegible]	7.84	4.22
16.56	32.48	516.75	277.24	1,[illegible]	7.10	3.46
[illegible]	32.77	614.50	277.24	1,501.83	7.[illegible]	[illegible]
[illegible]	31.16	497.25	277.24	1,[illegible]	7.12	3.91
[illegible]	40.15	601.11	277.24	1,418.49	7.22	3.75
80.[illegible]	[illegible]	521.00	277.24	1,300.[illegible]	[illegible]	3.81
100.23	88.25	521.56	277.24	1,417.[illegible]	7.71	4.07
[illegible]	[illegible]	525.90	277.24	1,371.21	7.12	[illegible]
102.11	50.[illegible]	599.96	277.24	1,380.82	7.06	4.61
41.[illegible]	8.25	625.00	277.24	1,391.87	6.05	4.26
[illegible]	43.56	525.00	277.24	1,252.75	[illegible]	5.45
101.21	17.46	525.00	277.24	1,229.70	6.64	0.05
[illegible]	40.[illegible]	625.00	277.24	1,163.44	6.32	4.09
07.57	30.01	525.00	277.24	1,290.[illegible]	8.54	4.02
[illegible]	86.62	625.00	277.24	1,408.78	7.41	3.11
201.77	[illegible]	615.00	277.24	2,010.31	10.71	7.01
110.39	85.26	665.10	277.24	1,477.[illegible]	6.01	3.78
74.[illegible]	[illegible]	[illegible]	277.24	2,[illegible]	7.52	3.48
[illegible]	$991.14	$18,621.50	$7,208.24	$71,091.[illegible]	Ave., $7.24	Ave. $4.21
8.[illegible]	2.4[illegible]	88.34	10.96	100.26		

tal cost, $[illegible]447.28.

ower; there are six Jenney, Indianapolis arc dynamos of 30 lamp power each. pended at the centre of the street, intersections between two lines, giving one lamp to ower. An average test of the lamps showed a pressure of 46.16 volts and a current of

ARC LAMPS.

City.	Total Cost of Plant, including Buildings.	Yearly Expenses.									
		Interest and Depreciation at 16 per cent.	Taxes and Insurance.	Superintendence and Labor.	Fuel.			Carbons.	Repairs.	Sundries.	Total.
					Kind.	Price per ton, cord, etc.	Cost.				
Aberdeen, Miss....	$10,000.00	$1,600.00	None given.	$1,320.00	Coal....	$2.75	$750.00	$127.75	$100.00	$50.00	$3,947.75
Aurora, Ill.........	18,831.56	3,013.05	$500.00	2,689.74	Soft coal.....	1.80	2,382.50	(*)	523.24	47.93	9,156.46
Bangor, Me........	34,141.01	5,462 56	None.	3,680.03	Water Power.			503.00	(†)	1.228.60	10,874.19
Bay City, Mich.....	30,000.00	4,800.00	None.	4,220.00	Shavings.....	....	1,429.79	518.34	321.72	363.05	11,652.90
Bloomington, Ill...	75,000.00	12,000.00	420.75	6,112.32	Coal..	1.75	2,615.00	1,080.00	(†)	4,733.68	26,961.75
Danvers, Mass......	15,579.09	2,492.65	112.50	1,540.00	Coal........ .	....	557.09	258.40	(†)	362.80	5,323.44
Dunkirk, N. Y.....	13,338.71	2,134.19	None given.	660.00	Coal...... ...	....	1,190 07	333.00	160.35	443.96	4,921.57
Fairfield, Iowa.....	5,000.00	800.00	None.	240.00	Coal..........	23.75	263.38	20.00	93.89	86.86	1,504.13
Goshen, Ind........	9,000.00	1,440.00	None.	960.00	Oil...........	....	804 00	120.00	100.00	(‡)	3,424.00
Lyons, Iowa........	17,350.00	2,776.00	None.	1,855.81	Pine strips...	0.90	900.00	243.71	440.63	280.07	6,496.22
Meadville, Pa......	20.000.00	3,200.00	56.00	2,280.00	Gas..........	....	400.00	396.00	(†)	1,000.00	7,332.00
Ottawa, Ill.........	16,000.00	2,560.00	25.00	2,200.00	Included in preceding.			700.00	400.00	(‡)	5,885.00
Paris, Ill...........	10,500 00	1,680.00	None.	120.00	Coal..........	1.75	720.00	175.00	100.00	100.00	2,895.00
St. Joseph, Mo.....	62.000.00	9,920.00	150.00	6,960 00	Coal..........	1.65	3,697.25	1,067.86	291.61	1,170.00	23,106.72
Sharpsburg, Pa.....	5,725.76	916.12	None.	720.00	Gas..........	....	480.00	153 00	120.00	(§)	2,389.12
Sherman, Tex......	10,000.00	1,600.00	None.	1,800.00	Coal..........	4.00	750.00	120.00	25.00	25.00	4,320.00
Topeka, Kans......	52,000.00	8,320.00	300.00	5,360.00	Coal..........	3.05	3,660.00	750.00	1,200.00	285.00	19,875.00
Xenia, Ohio........	18,500.00	2,960.00	20.00	1,800.00	Coal..........	2.20	1,525.00	350.00	250.00	850.00	7,755.00

* Included in fuel. † Included in sundries. ‡ Included elsewhere. § Included in repairs.

ARC AND INCANDESCENT.

City.	Total Cost of Plant, including Buildings.	Interest and Depreciation at 16 per cent.	Taxes and Insurance.	Superintendence and Labor.	Fuel Kind.	Price per ton, cord, etc.	Cost.	Carbons.	Repairs.	Sundries.	Total.
Allegheny, Pa.....	$175,000 00	28,000.00	$500.00	$25,000.00	Coal........	$1 05	$8,000.00	$4,250.00	$3,500.00	$2,250.00	$71,500.00
Brainerd, Minn....	40,000.00	6,400.00	40.00	2,500.00	Water Power.			150.00	200.00	50.00	9,340.00
Galion, Ohio.......	26,901.35	4,304.22	None.	1,641.50	Coal and oil	....	2,180 86	250.00	50.00	1,190.00	9,616.58
Galveston, Tex.....	39,990.00	6,398.40	None.	7,171.67	Slack coal.. Coal..	3.50 5.19	7,615.58	1,800.00	1,200.00	241.15	24,426.80
Herington, Kans...	30,000.00	4,800.00	None.	1,980.00	Coal...	2.43	2,400.00	300.00	275.00	100.00	9,855.00
Statesville, N. C....	8,500.00	1,360 00	82.00	1,200.00	Wood.....	3.60	750.00	145.00	75.00	50.00	3,662.00
Vancouver, Wash..	17,000.00	2,720 00	None given.	3,612.00	Wood......	....	600.00	390.00	150.00	350.00	7.822.00

INCANDESCENT.

City.	Total Cost of Plant, including Buildings.	Interest and Depreciation at 16 per cent.	Taxes and Insurance.	Superintendence and Labor.	Fuel Kind.	Price per ton, cord, etc.	Cost.	Carbons.	Repairs.	Sundries.	Total.
Chariton, Iowa.....	$24,600.00	$3,936.00	$50.00	$2,080.00	Slack coal..	$0.50	$1,500.00	(†)	$125.00	(†)	$7,691.00
Falls City, Nebr....	9,000.00	1,440.00	None.	2,050.00	Coal........	2.65	(*)	(*)	(*)	(*)	3,490.00
Tecumseh, Nebr....	7,000.00	1,120.00	30.00	1,000.00	Coal........	3.25	300.00	60.00	40.00	10.00	2,560.00

* Included in superintendence. † Included elsewhere.

the District of Columbia,[1] it has been placed at 10 per cent of the total investment for both plant and buildings. It seems to me that, even accepting that assumed ratio, the expenditures for current repairs ought to be deducted from the item.

Having thus obtained an approximately accurate expense account, the problem of ascertaining the annual cost per lamp becomes apparently simple. All that is necessary is to divide the total by the number of lamps operated. The results of the Electrical Commission are shown in Table IV.

We have here not only the cost per lamp per year, but also the cost per hour. The cost per hour is utterly worthless for any scientific use. The number of hours of lighting is too fluctuating a figure; the greater the number of hours the less the apparent cost per hour. If variations in the duration of nightly lighting vitiates to a certain extent the cost statistics per lamp per year, the variations in the number of hours take away every vestige of value from the figure representing the cost per hour. Furthermore, many of the limitations noted with respect to contract prices apply equally to the cost under municipal ownership. The municipality is usually circumscribed in its market; it is seldom permitted to sell its product to private consumers. It is likewise subject to the same influences as accrue to private companies from differences in the locations of lamps and wires.

III. General Comparisons.

Our examination of the nature of the statistics at hand being completed, we must next inquire how far these statistics may be used for purposes of general comparison. This question in reality resolves itself into how far we may rely upon a simple average of the results. Can we say that a specific contract price is so much below or so much above the average price paid by American municipalities? Can we say that the cost in a designated city is so much below or so much

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[1] 52nd Cong., 1st Sess., House Ex. Doc. No. 15.

TABLE IV. COST PER LAMP UNDER MUNICIPAL OWNERSHIP.

ARC LAMPS.

City.	Number of Lights.	Hours of Lighting.		Cost per Lamp.	
		Per Day.	Per Year.	Per Year.	Per Hour.
Aberdeen, Miss	35	8	2,920	$112.79	$0.0386
Aurora, Ill	83	7h 10m	2,622	110.32	.0421
Bangor, Me	146	(*)	3,600	74.48	.0207
Bay City, Mich	141	....	2,221	82.64	.0372
Bloomington, Ill	220	....	2,247	122.55	.0545
Danvers, Mass	75	4.847	1,769	70.98	.0401
Dunkirk, N. Y	60	10h 51m	4,000	82.03	.0205
Fairfield, Iowa	10	3.5	1,278	150.41	.1177
Goshen, Ind	31	9.75	3,559	110.45	.0310
Lyons, Iowa	59	7	2,555	110.11	.0431
Meadville, Pa	70	8	2,920	104.74	.0393
Ottawa, Ill	100	....	3,600	39.05	.0167
Paris, Ill	60	(†)	3,000	48.25	.0161
St. Joseph, Mo.	253	8	2,920	91.33	.0313
Sharpsburg, Pa	35	8	2,920	68.26	.0234
Sherman, Tex	43	7	2,555	100 47	.0393
Topeka, Kan	184	(‡)	3,600	107.74	.0299
Xenia, Ohio	80	(†)	3,300	97.74	.0326

* Dark to daylight. † Moon schedule. ‡ All dark hours.

ARC AND INCANDESCENT.

City.	Number of Lights.	Hours of Lighting.		Gross Cost per Lamp (Arc).		Receipts (from Rented Lamps).	Net Cost per Lamp (Arc).	
		Per Day.	Per Year.	Per Year.	Per Hour.		Per Year.	Per Hour
Allegheny, Pa	Arc 422 Incandescent 2,500	11 24	....	$106.40	......	None.	....	......
Brainerd, Minn	Arc 30 Incandescent 1,000	4.75	......	71.85	......	None given.	....	......
Galion, Ohio	Arc 71 Incandescent 600	10	......	73.41	......	$2,250.00	$56.22	......
Galveston, Tex	Arc 175 Incandescent 300	9	......	114.28	......	None.	....	......
Herington, Kan	Arc 20 Incandescent 500	5	......	140.79	......	4,200.00	80.80	......
Statesville, N. C.	Arc 30 Incandescent 220	Dark. 6	....	70.42	......	None given.	....	......
Vancouver, Wash.	Arc 35 Incandescent 540	12	......	87.89	......	None given.	....	......

INCANDESCENT.

City.	Number of Lights.	Hours of Lighting.		Gross Cost per Lamp.		Receipts (from Rented Lamps).	Net Cost per Lamp.	
		Per Day.	Per Year.	Per Year.	Per Hour.		Per Year.	Per Hour.
Chariton, Iowa	1,300	12	4,380	$5.92	$0.00135	Not given.	....	....
Falls City, Neb	400	4	1,460	8.73	.00599	$2,085.00	$3.51	$0.00240
Tecumseh, Neb	500	5	1,825	5.12	.00281	1,680.00	1.76	.00096

above the average cost of electric lighting under municipal ownership? If we can say so, then why not compare these two averages and thus learn which method of public lighting is less expensive,— that by contract with private parties or that of municipal ownership? All this has been done time and time again,[1] yet I have met but one argument in its support. It is claimed that all a city wants is to have its streets lighted. If it can get along with less illumination than its neighbor, so much to its advantage. If under municipal ownership a city does with less light than under private contract, it simply means that private companies force more light upon the cities under that régime than they require. The average represents annual illumination. Annual illumination is a concrete thing capable of comparison, and therefore a comparison of averages is a comparison of like things.

Such argument, I maintain, is merely specious. The many limitations and differentiating factors, which I have enumerated, preclude any comparison of averages whatever. In this case the average represents nothing. Unlike elements may produce the same cost statistics, and the same cost may represent totally different conditions. If the defective factors were in both instances the same, they might possibly be eliminated by combination and permit of a general use. Here this is not the case. The average is fictitious through and through.

It has sometimes been attempted to compare the cost of electric lighting in the same city under contract with private companies and under municipal ownership. Figures of this kind are valid so far as they go. But even where the city changes from one régime to another, by buying out the private corporation, or by constructing its own plant, we can never be certain that the conditions remain unchanged, that we are comparing similar services. Mr. R. J. Finley has, in a recent magazine article, adopted still a different procedure. He has compiled two tables representing the two systems, each table showing the cost of lighting in a number of cities specially chosen with reference to geographical situation and industrial conditions, in order to counterbalance the one against the other. The plan is ingenious. Sufficient data are given to convey a comprehensive idea of the situation, but Mr. Finley also gives way to the irresistible impulse to generalize with an average. His average, like the others, is misleading and meaningless.

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[1] I confess to have made this mistake once in my first essay on this subject, published in the *Independent*, March, 1889. The same error is found in Mr. Fransisco's *Municipal Lighting*, in the report of the Engineer Commissioner cited, and in Mr. Finley's article in the *Review of Reviews*, February, 1893; also in the *Census Bulletin*, and others.

If this review of the cost statistics of public electric lighting can serve any useful purpose, it must be to emphasize the fact that in such matters simplicity is deception. It is useless to seek to represent a complicated process by a single numerical figure. The statistics themselves are valuable, but must be employed as bases of comparison only with the utmost care, and with due allowance for the many limitations which affect their accuracy.

VICTOR ROSEWATER.